Challenges of working with industry

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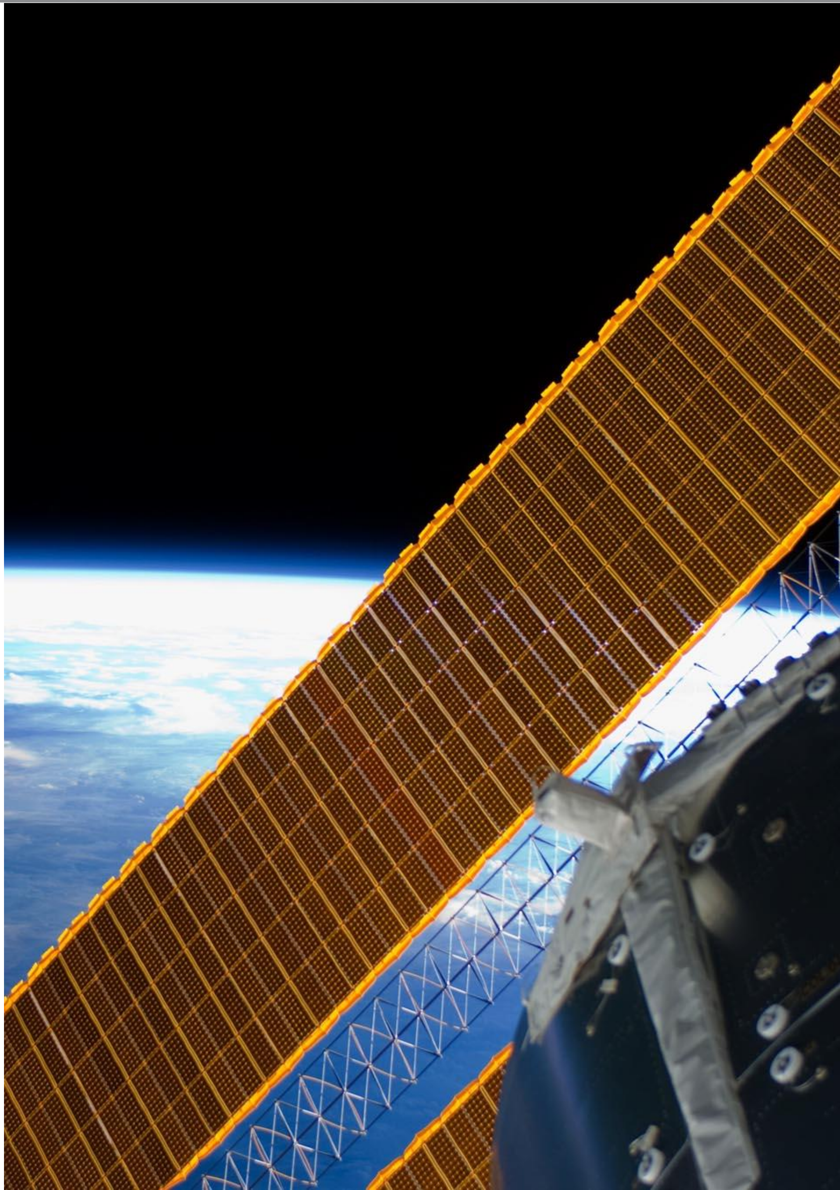
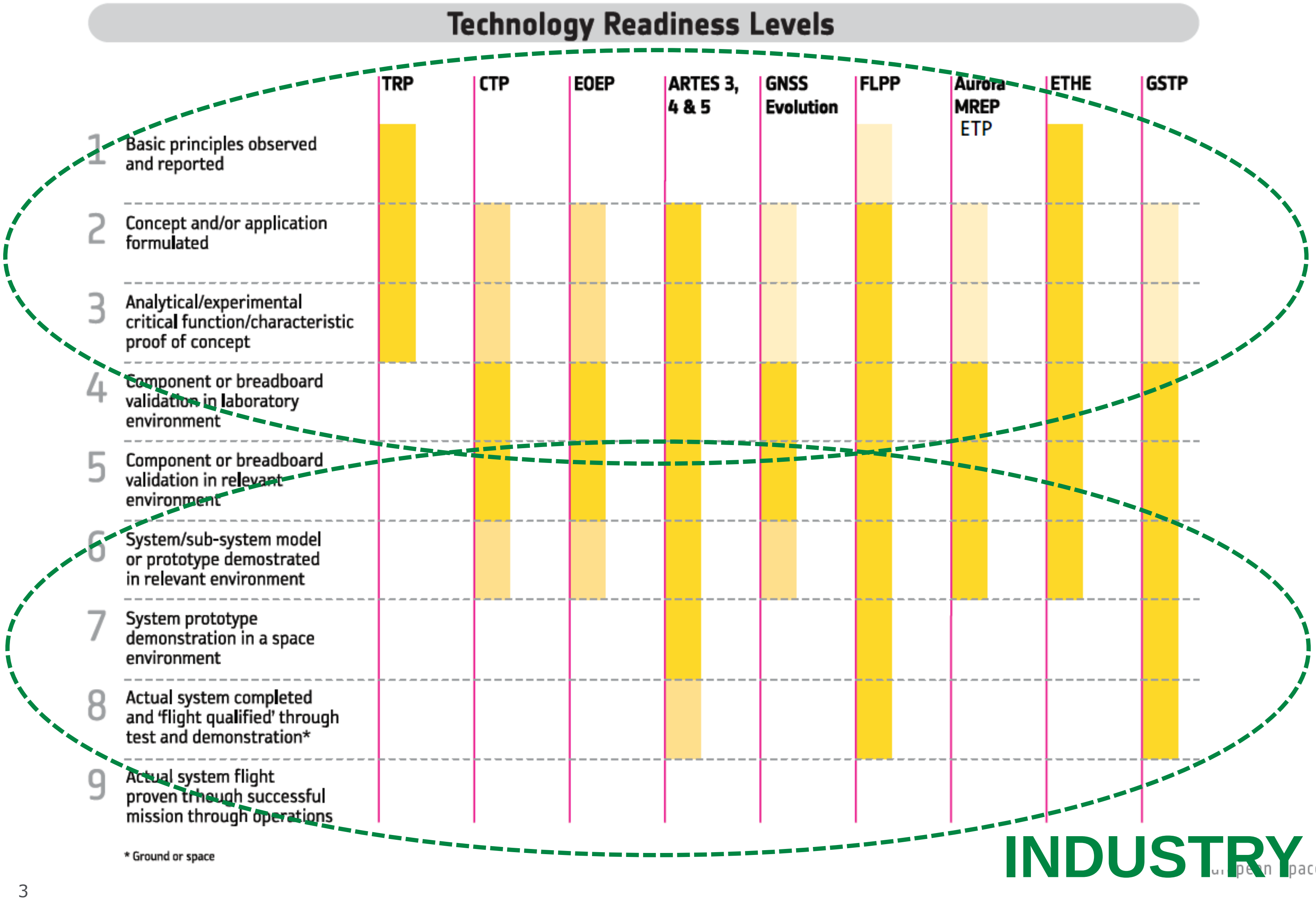
TECHNOLOGY PROGRAMMES: OBJECTIVES

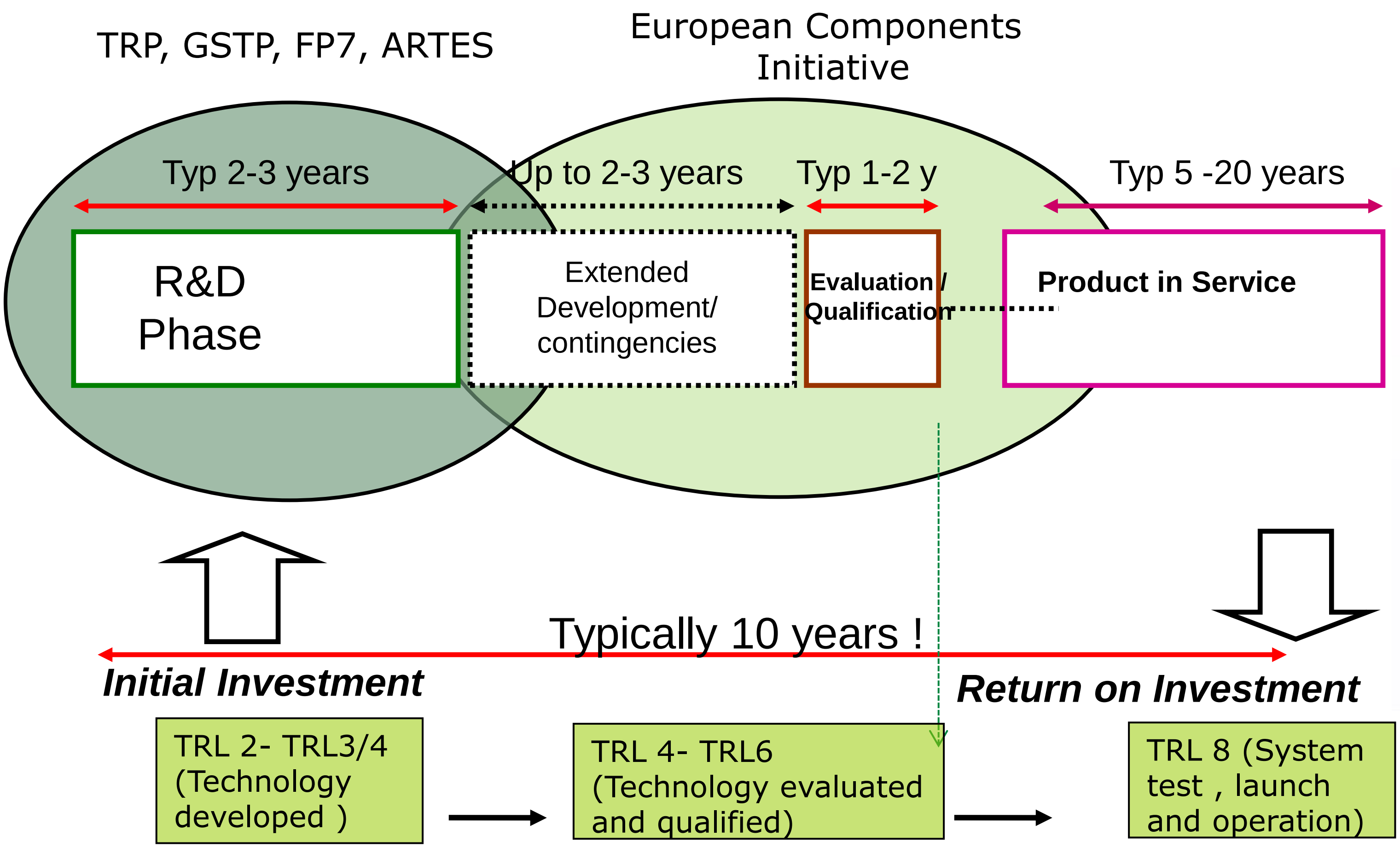
- **Enabling** missions of ESA and national programmes by developing technology
- Fostering **innovation** by creating new products
- Supporting the **competitiveness** of European industry
- Improve European **technological non-dependence** and the availability of European sources for **critical technologies.**
- Facilitate **spin-in** from outside the space sector

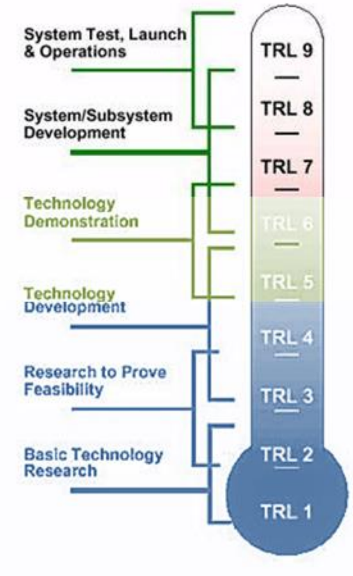


TECHNOLOGY PROGRAMMES



Timeline from R&D to Commercialization





Examples of qualified products in service:
AVX Type 1 capacitors since 1983, Infineon CFY66/67 GaAs HEMT since 1994….

Industry

- Biggest contracts are for the spacecraft procurement, and dominated by the 2 big players, Airbus and Thales Alenia
- But geographic return rules require distribution to nationalities (used to be ~30 subcontracts but with expansion up to 100!)
- SMEs hope to gain leverage on future business for one of these subs by building critical expertise in some technology
- Limit typically of 8% profit on top of agreed hourly rates
- Other SMEs bid space contracts for spin-off, or for PR reasons

Industry

- Contractual relation between ESA and the industry
- Once a large contract is underway it can be very inflexible and expensive to modify via. CCN for example
- However, arguably industry can drive and control the schedule better than academic entities?
- Engineering resources of industry of course can be much greater than academic institutes for problem phases, but it will lead to a cost and schedule constrained solution, not necessarily a performance compliant one
- Pre-phase A of a mission is often seen a loss leader, requires different skills, and in the end will try to offer an optimistic view in order to get selected
- Competitive industries for phase A are supposed to help cap costs – Does it work – they both want to offer the target price with similar solutions

Tendering Process

- Strictly defined regulations that aim to keep competition for contracts as open as possible
- Tender Evaluation Board is populated from a range of directorates, and it sets the criteria for tender evaluation and verifies the adequacy of Statement Of Work
- Typical criteria: Engineering approach, Technical Understanding, Facilities and experience, schedule and work flow, Management and Contract conditions (10-30% marks for each)
- Not allowed explicitly to request or fix for specific industry
- ***Need to craft SoW and tender special conditions to select the favoured supplier, but also to guide the eventual process of the contract with suitable milestones and associated payments, defining deliverables***

Costs to ESA

- Anecdotally industry charges ESA more than it would to an academic or local agency
- The agency accounting oversight is monolithic and cannot accommodate different classes of activity (development versus spacecraft prime) to address this
- There is an internal costing experts office that provides independent view of large system contracts, but they are only calibrated against proposal costs - not the eventual project cost (partly a concern of the project management to hide cost growth problems ?)
- This effort is elaborated via detailed models that use metrics of mass/power, complexity, TRL and heritage to estimate a "cost by analogy" as well as bottom up unit costing

Monitoring Progress

- Clear milestones and deliverables agreed up-front focus the work and allow for tracking progress
- ***We used to find involvement in a measurement programme was invaluable in drawing the players into commitment and buy-in (e.g. measure detectors or optics at synchrotron)***
- Milestone meetings need to be called frequently ***but*** the Agency is discouraging more and more the face-to-face contact
- Technology management, examples SMEs (optics, X- and Gamma, detectors, navigation, Formation Flying)
- In Science these are often open-ended in that there may be a performance goal for some loosely defined future mission, - a best efforts basis occasionally results: goes on to refine the inputs for a future mission proposal

Industry vs Academic

- Sometimes the academic institute can be apprehensive about contractual constraints.
- Not suited for documenting the progress to lead towards product assurance issues
- Sometimes they partner with industry to address this, as well as to improve strategic positioning of national groups
- The management by the industry takes disproportionate budget?
- Knowledge (and process control) is frequently personnel specific – can be a continuity problem to mission implementation

Examples

- Gamma-ray focussing: Bragg crystals, either copper mosaics or curved semiconductor planes
- Looking for innovative solutions but with fabrication processes that could be reliably carried forward for early phase demonstrator
- Academic institutes reluctant to focus on the process documentation and brought in industry oversight
- The latter ate half the budget with no real performance impact
- Silicon pore optics – SME research oriented team demonstrated principles
- A mass production will be needed, so a industry consortium to be built up and transfer key production techniques
- But a one-off application, so tricky to get motivation

Pore Optics – prototype to "mass production"

- In technical reviews, the ESA engineering staff were reserved in their lack of experience in confronting "mass production" phase for the optics
- Already in phase A we have to consider a proto consortium of industries with the right skill set, geographics distribution etc.
- However would probably like to place all processes on one site
- System prime has been very conservative in engineering solutions for the optics assembly (too massive)
- How to interest and motivate potential MEMS industry in one-off application, with small run that is vastly less than consumer volumes ! (**INFINEON)**
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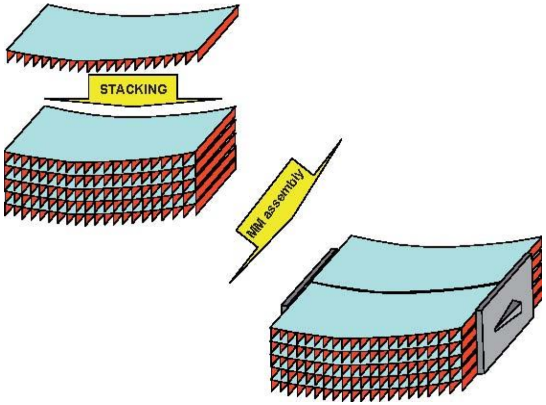

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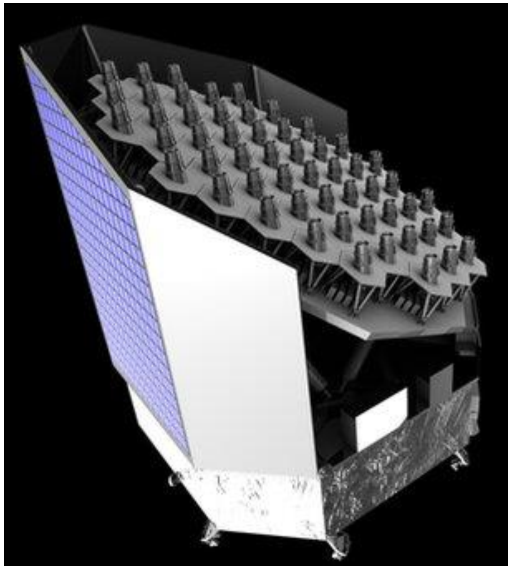
Detectors

- While European industry pre-eminent in space-based CCD sensors (E2V) a continual concern about the long term viability of the organisation
- Large flight projects can soak up huge fraction of capacity
- Defining specifications and space qualification – who does what to define deliverable success?
- One-off designs can optimise a whole payload and bring about resource saving = mission cost (eg radiation hardened versus shield mass)
- But are we the qualifying the actual new device or qualifying a design and manufacture process?
- IR detectors – heavily dominated by US manufacturers, leveraged through defence spending and NASA strategic aims
- Only recently ESA has been funding 3 parallel European suppliers, but without the performance premium of Teledyne

Detectors – example problems



- Very large focal plane systems
- GAIA ~100 CCDs, PLATO ~30 telescopes each with 4 large CCDs
- How much performance can be lost by accepting some cosmetic defects, an average noise response, not trimmed operating voltages etc..
- Is it best to let the manufacturer to all science performance acceptance tests?
- Is this dependent on the differences between manufacturer test electronics versus the flight electronics made elsewhere?
- Academic institutes can be involved in testing, but then how does the prime industry guarantee the eventual mission performance

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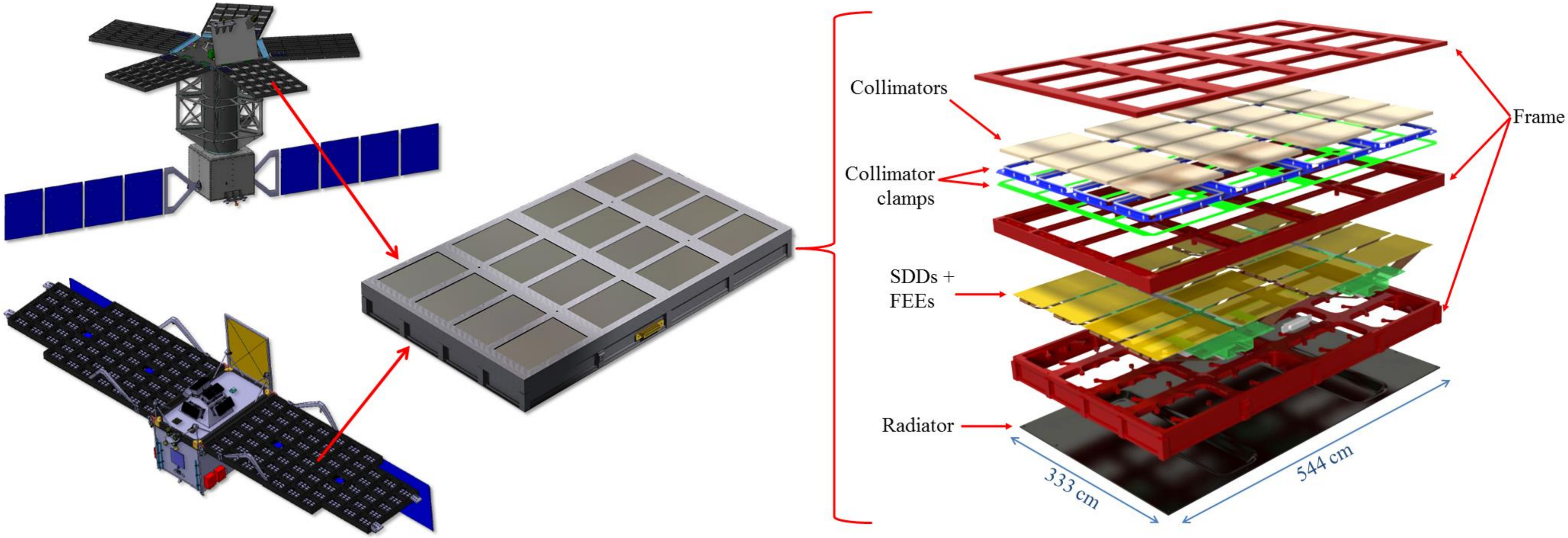

- Large Observatory for X-ray Timing
- 20 sq m of SDDs and MCP collimators
- Perceived that schedule would be big risk
- Was able to demonstrate that industries and industry standard processes for placement, bonding glueing etc. were already in place

Academic Institutes

- Interested in the end science product and hence mainly in performance of instruments
- Disparate engineering capabilities depending on heritage
- Funding stability is variable between countries, but flexible for manpower
- Harmonising schedules between member state participants can be very difficult, as can matching geographic spread to sub-system capabilities
- Delays due to payload development can be critical – jeopardises the interfaces with spacecraft resources & once industry contract is running the annual cost is large
- Documenting development, interfaces, operations, maintenance (cradle-grave) is difficult to enforce
- NO FORMAL MEMORANDUM OF UNDERSTANDING